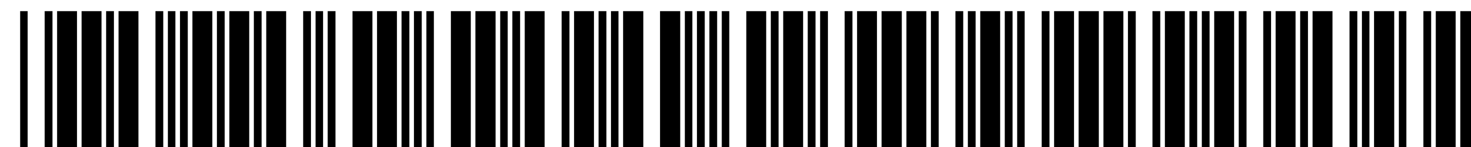
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(54) **PACKAGE STRUCTURE OF OPTICAL MODULE HAVING PRINTED SHIELDING LAYER AND ITS METHOD FOR PACKAGING**

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H01L 33/58 (2010.01)

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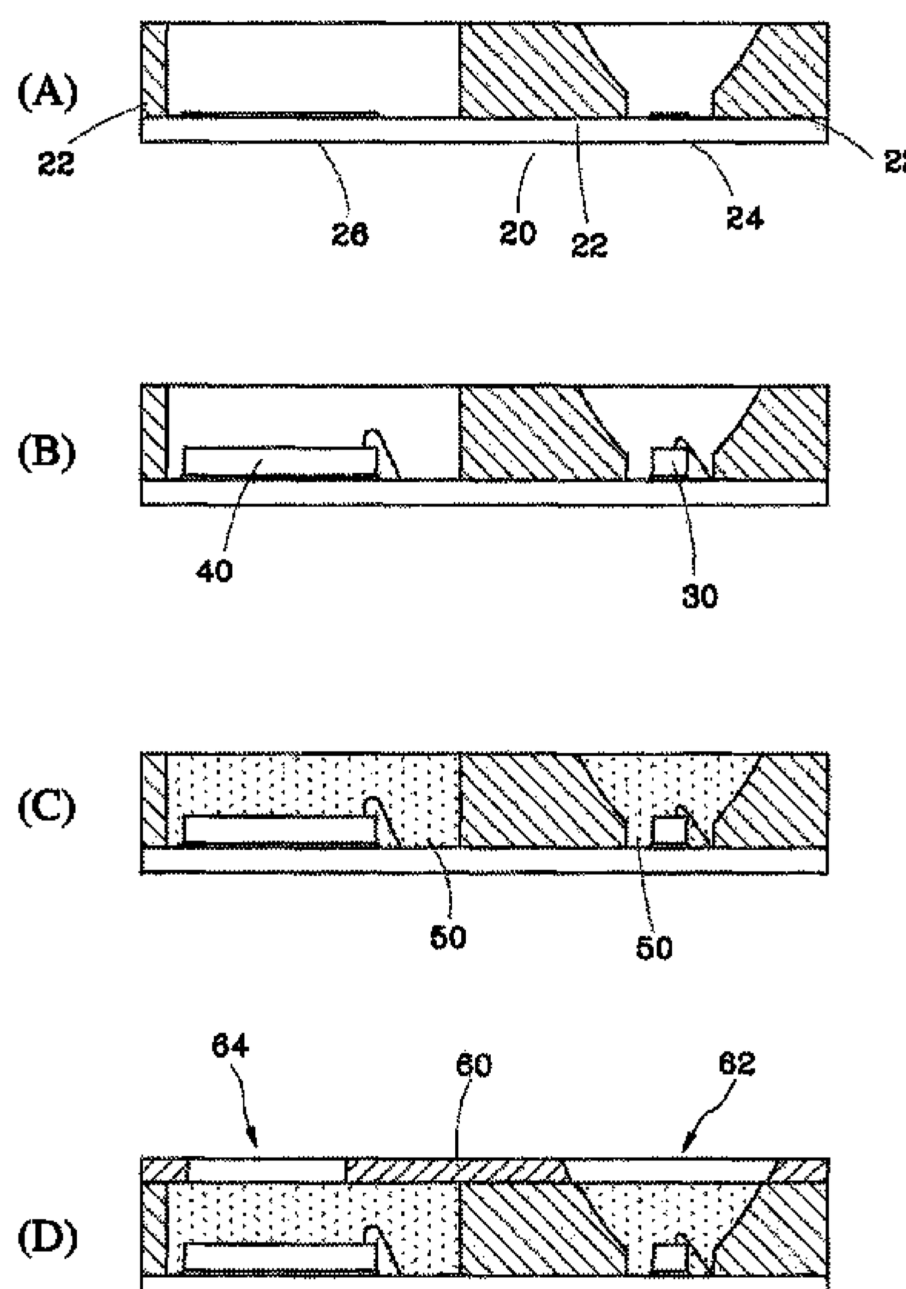
(57) **ABSTRACT**

A package structure of an optical module includes: a substrate having a frame defined with a light-emitting region and a light-admitting region; a light-emitting chip disposed at the light-emitting region of the substrate; a light-admitting chip disposed at the light-admitting region of the substrate; two encapsulants formed in the frame and enclosing the light-emitting chip and the light-admitting chip, respectively; and a shielding layer formed on the frame and the encapsulants and having a light-emitting hole and a light-admitting hole, wherein the light-emitting hole and the light-admitting hole are positioned above the light-emitting chip and the light-admitting chip, respectively. The optical module package structure uses an opaque glue to reduce costs and total thickness of the package structure.

5 Claims, 2 Drawing Sheets



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(58) **Field of Classification Search**
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See application file for complete search history.

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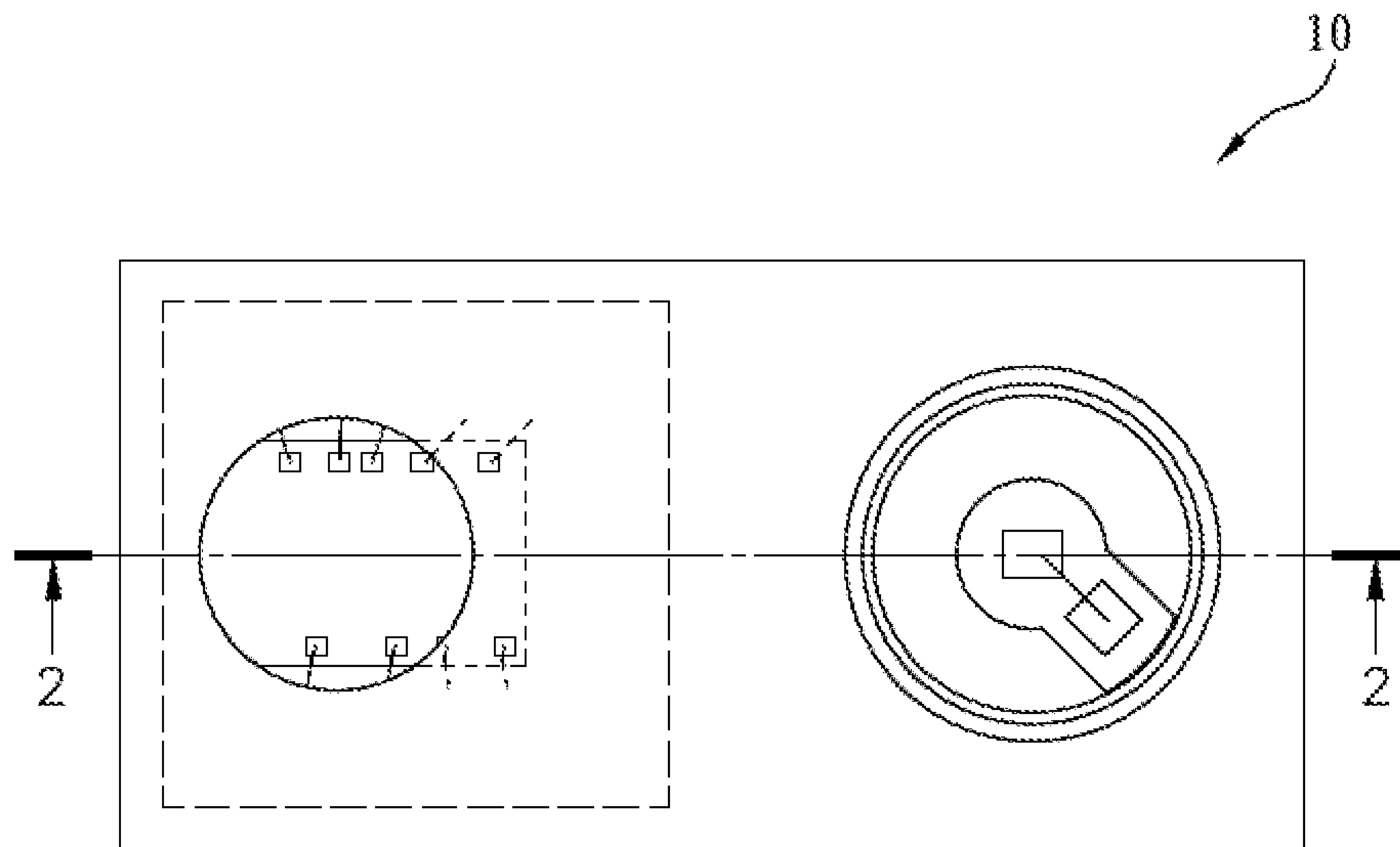

FIG. 1

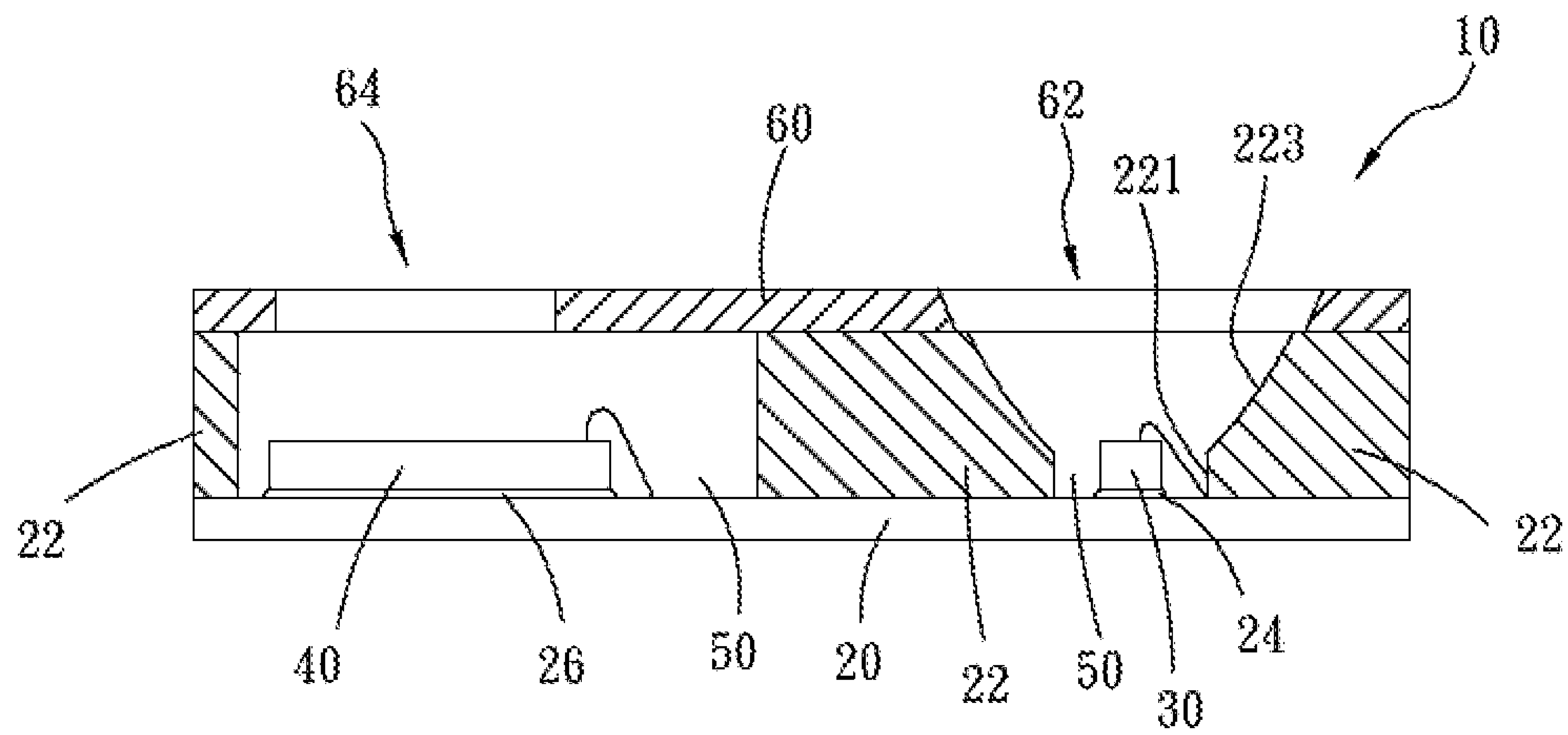

FIG. 2

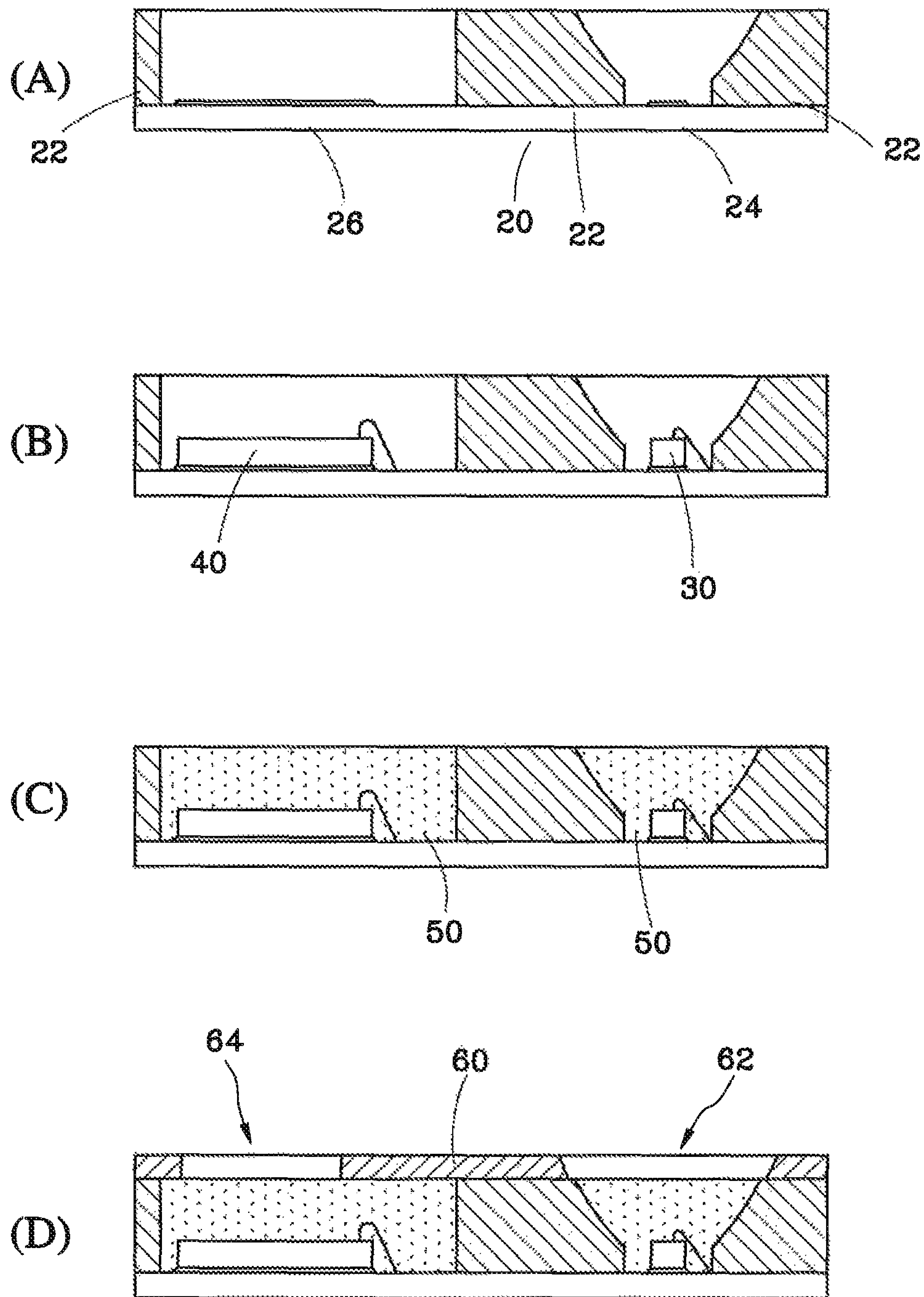

FIG. 3

PACKAGE STRUCTURE OF OPTICAL MODULE HAVING PRINTED SHIELDING LAYER AND ITS METHOD FOR PACKAGING

BACKGROUND OF THE INVENTION

1. Technical Field

The present invention relates to package structures, and more particularly, to a package structure of an optical module.

2. Description of Related Art

At present, an optical proximity sensing module is regarded as a mainstream technology choice for use with the new-generation smart electronic devices (such as smartphones). If the electronic device is brought close to the human ear (for face recognition) or put in a pocket, the optical proximity sensing module will turn off the screen display of the electronic device right away to save power and prevent an inadvertent touch on the screen display, thereby enhancing ease of use. The optical proximity sensing module comprises a light-emitting chip (such as a light-emitting diode, LED) for emitting a light beam. The light beam reflects off an object surface to fall on a light-admitting chip and convert into an electronic signal for subsequent processing. For instance, Taiwan patent M399313 discloses a proximity sensing package structure which comprises a base, a dam extending vertically and enclosing the base, and a lid disposed on the dam, so as to form a receiving space, wherein the receiving space has therein a partition board for dividing the receiving space, such that a light-emitting chip and a light-admitting chip can be separately disposed on a substrate to shun mutual light beam-related interference which might otherwise result in deterioration of product performance.

However, smart electronic devices nowadays have a trend toward reduction of thickness. The packaging process of the aforesaid patent requires that a lid be fixed to a dam and a partition board from above; as a result, evidently, the package structure incurs high material costs. Furthermore, the lid is of a considerable thickness, which restrains the extent of reduction in the total package structure height.

SUMMARY OF THE INVENTION

It is an objective of the present invention to provide a package structure of an optical module to cut costs and reduce total package structure thickness effectively.

In order to achieve the above and other objectives, the present invention provides a package structure of an optical module, comprising: a substrate having a frame defined with a light-emitting region and a light-admitting region; a light-emitting chip disposed at the light-emitting region of the substrate; a light-admitting chip disposed at the light-admitting region of the substrate; two encapsulants formed in the frame and enclosing the light-emitting chip and the light-admitting chip, respectively; and a shielding layer formed on the frame and the encapsulants and having a light-emitting hole and a light-admitting hole, wherein the light-emitting hole and the light-admitting hole are positioned above the light-emitting chip and the light-admitting chip, respectively.

The shielding layer is formed by printing or transfer printing.

The shielding layer is made of an opaque plastic.

The encapsulants are made of a transparent silica gel.

The substrate is a non-ceramic substrate made of an organic material, such as Bismaleimide Triazine.

The present invention further provides a method for packaging an optical module. The method comprises the steps of:

(a) defining the light-emitting region and the light-admitting region on the substrate;

(b) forming the frame on the substrate;

(c) connecting electrically the light-emitting chip and the light-admitting chip to the substrate;

(d) filling the frame with a transparent encapsulant for covering the light-emitting chip and the light-admitting chip; and

(e) forming an opaque shielding layer on the frame and the encapsulant by printing or transfer printing.

The electrical connection step is achieved by a wire bonding process and a die attaching process.

Hence, the present invention provides a package structure of an optical module, wherein a light-emitting hole and a light-admitting hole are formed by means of an opaque glue to shield portions of a light-emitting chip and a light-admitting chip, thereby reducing packaging costs and total thickness.

To enable persons skilled in the art to gain insight into the framework, features, and objectives of the present invention and implement the present invention accordingly, the present invention is hereunder illustrated with a preferred embodiment and the accompanying drawings and described in detail. However, the description below is merely intended to illustrate the technical solution and features of the present invention and the embodiment thereof. All simple modifications, replacements, or constituent component sparing made, without going against the spirit of the present invention, by persons skilled in the art after understanding the technical solution and features of the present invention should fall within the claims of the present invention.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The structure, features, and advantages of the present invention are hereunder illustrated with a preferred embodiment in conjunction with the accompanying drawings, in which:

FIG. **1** is a top view of an optical module package structure according to a preferred embodiment of the present invention;

FIG. **2** is a cross-sectional view of the optical module package structure taken along line **2**-**2** of FIG. **1** according to the preferred embodiment of the present invention; and

FIG. **3** is a schematic view of the process flow of a packaging method according to the preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENT OF THE INVENTION

Referring to FIG. **1** through FIG. **3**, an optical module package structure **10** provided according to a preferred embodiment of the present invention comprises a substrate **20**, a light-emitting chip **30**, a light-admitting chip **40**, two encapsulants **50**, and a shielding layer **60**

The substrate **20** is a non-ceramic substrate made of an organic material, such as Bismaleimide Triazine. The substrate **20** has a frame **22**. The frame **22** is defined with a light-emitting region **24** and a light-admitting region **26**.

The light-emitting chip **30** is disposed at the light-emitting region **24** of the substrate **20**.

The light-admitting chip **40** is disposed at the light-admitting region **26** of the substrate **20**.

The encapsulants **50** are made of a transparent silica gel and formed in the frame **22** to enclose the light-emitting chip **30** and the light-admitting chip **40**, respectively.

The shielding layer **60** is made of an opaque plastic and formed on the frame **22** and the encapsulants **50** by printing or transfer printing. The shielding layer **60** has a light-emitting hole **62** and a light-admitting hole **64**. The light-emitting hole **62** and the light-admitting hole **64** are positioned above the light-emitting chip **30** and the light-admitting chip **40**, respectively. The light-emitting region **24** and the light-admitting region **26** are independent from each other. The light-emitting region **24** has a first section adjacent to the substrate **20** and a second section adjacent to the light-emitting hole **62**. The first and second sections have a border **221**, **223** with the frame **22** which is perpendicular to the substrate **20** in the first section and expands outwardly toward the light-emitting hole in the second section.

Referring to FIG. **3**, A through D, there is shown a schematic view of the process flow of optical module packaging according to the present invention. The first step A involves defining the light-emitting region **24** and the light-admitting region **26** on the single substrate **20** of each substrate array and then forming the frame **22** on the substrate **20**. In the second step B, the light-emitting chip **30** and the light-admitting chip **40** undergo a die attaching process and a wire bonding process so as to be disposed at the light-emitting region **24** and light-admitting region **26** of the substrate **20**, respectively, In the third step C, the frame **22** is filled with a transparent the encapsulants **50**, such that the encapsulants **50** cover the light-emitting chip **30** and the light-admitting chip **40** to not only reduce the transmission loss and distortion of the light beam being transmitted from the light-emitting chip **30** to the light-admitting chip **40** but also protect the chips **30**, **40**. In the fourth step F, the opaque shielding layer **60** With the light-emitting hole **62** and the light-admitting hole **64** is formed on the frame **22** and the encapsulants **50** by printing or transfer printing, wherein the light-emitting hole **62** and the light-admitting hole **64** are positioned above the light-emitting chip **30** and the light-admitting chip **40**, respectively. Hence, the present invention is characterized in that: an opaque shielding layer **60** is formed by printing or transfer printing; given the shielding layer **60** with the light-emitting hole **62** and the light-admitting hole **64**, different portions of the encapsulants **50** are displayed and shielded, respectively, such that the optical module package structure **10** features reduced costs and total thickness.

In conclusion, the light beam emitted from the light-emitting chip **30** of an optical module package structure **10** passes through the encapsulants **50**, penetrates the light-emitting hole **62** of the shielding layer **60**, and falls on the surface of an object, such that the light beam reflected off the surface of the object is admitted to the light-admitting hole **64** of the shielding layer **60** before entering the encapsulants **50**. Afterward, the focused light beam falls on the light-admitting chip **40**. Eventually, the light-admitting chip **40** converts a received light signal into an electronic signal for subsequent computation. The present invention is characterized in that, during the process of emitting and receiving the light beam, each of the light-emitting chip **30** and the light-admitting chip **40** is positioned in independent space to avoid mutual interference resulting from receiving and transmitting the light beam. In addition, the shielding layer **60** is an opaque glue and formed by printing or transfer printing. The light-emitting hole **62** and the light-admitting hole **64** of the shielding layer **60** shield portions of the encapsulants **50**, such that the optical module package structure **10** not only keeps the predefined effect of the optical emission and reception, but reduces the packaging cost and total structural thickness.

Constituent elements disclosed in the aforesaid embodiment of the present invention are illustrative rather than restrictive of the present invention. The replacements or changes of other equivalent: elements should still fall within the appended claims of the present invention.

What is claimed is:

1. A method for packaging an optical module, the method comprising the steps of:

(a) defining a light-emitting region and a light-admitting region on a substrate;

(b) after step (a), forming a frame with a flat top surface on the substrate;

(c) after step (b), connecting electrically a light-emitting chip and a light-admitting chip to the substrate;

(d) after step (c), filling the frame with a transparent encapsulant having a flat top surface flush with the flat top surface of the frame for covering the light-emitting chip and the light-admitting chip; and

(e) after step (d), forming an opaque printed shielding layer on the flat top surface of the frame and the flat top surface of the encapsulant by one of printing and transfer printing;

wherein the light-emitting region and the light-admitting region are independent from each other; the light-emitting region has a first section adjacent to the substrate and a second section adjacent a light-emitting hole, the first and second sections having a border with the frame which is perpendicular to the substrate in the first section and expands outwardly toward the light-emitting hole in the second section.

2. The method of claim **1**, wherein the electrical connection step is achieved by a wire bonding process and a die attaching process.

3. The method of claim **1**, wherein the substrate is made of Bismaleimide Triazine.

4. The method of claim **1**, wherein the shielding layer is an opaque glue.

5. The method of claim **1**, wherein the shielding layer shields portions of the encapsulant.

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